



Materials Engineering Branch

TIP*



No. 065 Co-sputtered MoS₂ for Spacecraft Lubrication

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Molybdenum disulfide (MoS₂) is a good solid film lubricant for vacuum and spacecraft applications. Thin films of MoS₂ are particularly applicable for extremely low temperatures where the best space qualified greases stiffen and cannot be considered. Films of MoS₂ applied to surfaces by burnishing, bonding and sputtering have found countless uses on spacecraft hardware with varied success. MoS₂ is not particularly good for air operation.

One method by which MoS₂ can be applied is by direct current (DC) sputtering. This vacuum process produces thin films of from 750 to 8000Å onto metallic surfaces that are pre-cleaned by argon ions and then sputtered with MoS₂ to produce the desired thickness. Test data show that the kinetic friction of MoS₂ films that have been aged 24 hours exhibit a greater variation in coefficient of friction than do freshly prepared films. This does not mean that these aged films are non-lubricating but rather that there are more ideal characteristics such as a uniform coefficient of friction.

Researchers have found that the incorporation of metals into the sputtered MoS₂ matrix changes the film's properties beneficially. Principally, the improved film is harder and produces less wear debris which improves operating life. By co-sputtering MoS₂ with nickel and controlling the nickel content to an optimum of 5 to 8%, these improvements are achieved. In summary, the lubrication properties of MoS₂ co-sputtered with about 7% Ni is superior to the conventional sputtered MoS₂ process.

Due to the complex process parameters, it is recommended that for any sputtered films, proof parts be processed with the hardware. These parts should be evaluated as to the application with respect to wear rates and film thickness. Hohman Plating and Manufacturing, Inc. has furthered the development of sputtered and co-sputtered films as reported in a proprietary Hohman Specification.

References

1. Bernard C. Stupp, "Synergistic Effects of Metals Co-Sputtered with MoS₂," paper presented at the International Conference on Metallurgical Coatings, San Francisco, CA. April, 1981.
2. Hohman Plating and Manufacturing, Inc., proprietary Hohman Specification HPS 2809, "DC Triode Co-Sputtered Molybdenum Disulfide and Nickel." May 23, 1983.